Understanding Fiji's declining foreign reserves position

Paresh Kumar Narayan and Seema Narayan

This article examines the volatility in Fiji's foreign reserves—in particular, whether shocks have an asymmetrical effect on volatility and whether shocks have a persistent impact on volatility. In the pre-coup period (1975–86), shocks had a temporary effect on volatility; in the coup period (1987–2006), shocks had a more lasting impact. In the pre-coup period, negative shocks contributed more to foreign reserves volatility than positive shocks; but in the period including the coups, positive shocks increased the volatility of foreign reserves more than negative shocks. The reasons for, and the policy implications of, this asymmetrical behaviour are explored.

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Since 1987, Fiji's economic growth has been substantially slowed by several coups (Narayan and Smyth 2005, 2006; Narayan and Prasad 2006; Prasad and Narayan 2005). As well as reducing private investment levels (Narayan 2004a), coups have significantly increased the 'brain drain' (Narayan and Smyth 2006). In the past decade, the Fijian government targeted GDP growth rate of at least 5 per cent per annum (Kubuabola 2002). In the period 1987–2005, however, the average annual economic growth rate was only 2.6 per cent. In the period 2000–05, the annual average growth rate of 1.6 per cent was even further below expectations. After the December 2006 coup, GDP fell by about 6.6 per cent in 2007 and was projected to decline further in 2008 and 2009. The outlook for economic growth is bleak.

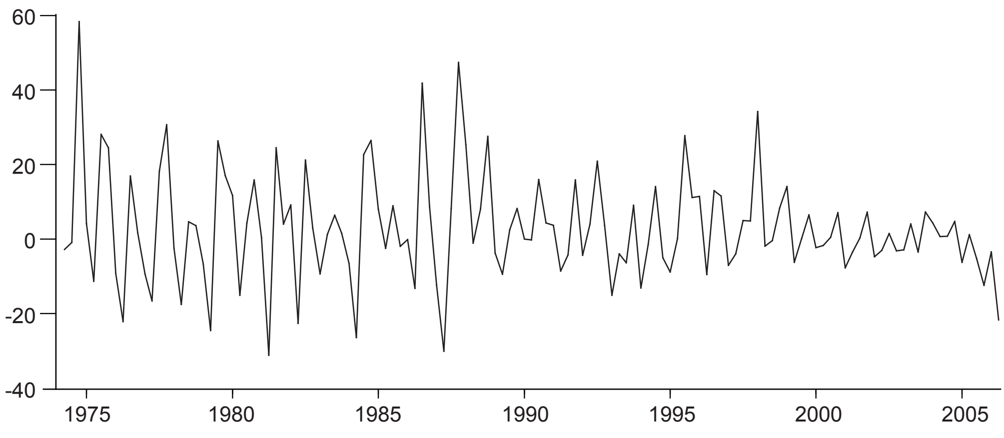
Fiji's export performance, based on an export-led industrialisation strategy, has also failed to diversify exports. Moreover, the growth in imports has exceeded the growth in exports, leading to current account deficits (Narayan and Narayan 2004). The failure of Fiji's export-led growth strategy to boost exports forced authorities to twice devalue the currency in the past two decades: by 33 per cent in 1987 after the military coups and by 20 per cent in 1998 after the East Asian financial crisis. Despite these decisions, the gap between exports and imports has not narrowed. The Reserve Bank of Fiji (RBF) argues that Fiji's import bill is relatively high because of strong consumer demand for imported goods. The RBF's response has been to raise interest rates. It raised the official interest rate in October 2005 and, less than six months later, on 24 February 2006, it raised rates again from 2.25 per cent to 3.25 per cent. The RBF (2006) justified the rate rise with the following statement

> The decision was made after reviewing economic conditions since the last interest rate hike in October 2005… Recent economic data suggests [sic] that consumer demand continues to increase, supported by strong credit growth. The rising consumer credit is of some concern. International oil prices remain high. The board noted that these factors are adding to our growing import bill. This trend is not sustainable given the lacklustre performance of our exports industry. A small open economy which is driven by consumption is unsustainable. Therefore, the Board deemed it necessary to take a further measure to reign in the credit expansion for the protection of our overall macroeconomic stability.

In January 2006, Fiji's official foreign reserves stood at F$850.1 million, sufficient to cover four months of imports of goods. At the end of July 2006, however, reserves had declined to F$621.5 million, sufficient to cover only 2.6 months of imports. The declining export performance and growing import demand, reflected in the steady decline in Fiji's official foreign reserves, led to speculation of devaluation. A recent study by Narayan and Narayan (2006) predicted that devaluation was just a matter of time.

Against this background of events, with their implications for the behaviour of foreign reserves, this analysis aims to model the volatility of Fiji's foreign reserves. A plot of the growth rate of foreign reserves reveals high oscillation, suggesting high volatility (Figure 1). We explore this volatility using the generalised autoregressive conditional heteroskedasticity (GARCH) and the exponential GARCH (EGARCH) models proposed by Bollerslev (1986) and Nelson (1991), respectively. The GARCH model assumes that positive and negative shocks

Figure 1 **Quarterly growth rate of Fiji's foreign reserves, Q1 1975 – Q2 2006**



Source: RBF, Quarterly Reviews, various issues have a symmetrical effect on the volatility of foreign reserves. The EGARCH framework, on the other hand, allows us to: 1) model asymmetric effects of shocks on volatility—the idea that negative and positive shocks have different effects on volatility; and 2) evaluate whether shocks to volatility are persistent.

A positive shock to foreign reserves, such as policies to boost exports, including devaluations, will lead to a rise in foreign reserves. Negative shocks will reduce foreign reserves. These include policies and activities that lead to capital outflows and constrain capital inflows. While positive and negative shocks lead to an increase in volatility, the question is which type of shock increases volatility more?

The data used in the analysis are quarterly and cover the period from the first quarter 1974 to the second quarter 2006. The sample is divided into two sub-samples—namely, a pre-coup sample period (Q1 1974 – Q4 1986) and a coup sample period (Q1 1987 – Q2 2006). The GARCH and EGARCH models are estimated for these three periods. This exercise is important because it allows us to judge whether volatility in foreign reserves has changed during the coup period. From a policy point of view, this information is crucial, because volatility, particularly if it is due to negative shocks, can create macroeconomic instability, including speculation about devaluation.

Briefly foreshadowing the main results, we find that there are significant ARCH and GARCH effects in the growth rate of Fiji's foreign reserves. The GARCH model results suggest that volatility persistence is significant only in the coup period (after 1986). This means that the impact of shocks is long lasting in the coup period. The EGARCH modelling results reveal that the volatility of foreign reserves is asymmetric. The evidence suggests that in the pre-coup period negative shocks led to a greater increase in foreign reserves volatility than positive shocks, while in the coup period there is evidence suggesting positive shocks made the foreign reserves more volatile than negative shocks. In terms of volatility persistence, we find that shocks to foreign reserve volatility are persistent in the post-coup period but not in the pre-coup period.

Modelling framework

There are now two types of volatility models, the ARCH and GARCH models, introduced by Engle (1982) and Bollerslev (1986), respectively, to choose from when the objective is to examine volatility. There are various reasons for the presence of ARCH effects in macroeconomic time series.[1] ARCH effects can arise from parameter instability (or structural breaks) (Tsay 1987) or non-linear transformation of business time into calendar time (Stock 1987). Our modelling framework draws on the GARCH and EGARCH models; the motivation for this was explained earlier.

We assume a conditional normal distribution and specify $ARMA(p,q) - EGARCH$ (1,1) and $ARMA(p,q) - GARCH$ (1,1) models with the following mean and variance structures

Mean equation

$$er_t = \sum_{i=1}^{p} \delta_i \, er_{t-i} + \eta_t + \sum_{j=1}^{q} \vartheta_j \, \varepsilon_{t-j} \tag{1}$$

Variance equations for GARCH and EGARCH, respectively, are:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \tag{2}$$

$$\log\left(\sigma_t^2\right) = \omega + \alpha\left(\left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| - \sqrt{\frac{2}{\delta}}\right) + \gamma\frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \beta\log\left(\sigma_{t-1}^2\right) \quad (3)$$

Here, *er* is the growth rate of foreign reserves. The EGARCH model differs from the GARCH model in a number of ways. First, unlike the GARCH model, it does not impose any restrictions on α, γ and β. Second, unlike the GARCH model, there is provision for oscillatory behaviour in the conditional variance since the β coefficient can be either negative or positive. The estimate of β allows one to evaluate whether shocks to the variance are persistent or not. Nelson (1991) shows that $|\beta| < 1$ ensures stationarity and ergodicity for the EGARCH (1, 1). Third, the EGARCH model allows one to judge asymmetric volatility, which is captured by the parameter γ. While both positive and negative shocks increase volatility, if $\gamma > 0$, the implication is that positive shocks give rise to a larger increase in volatility than negative shocks, and vice versa. Fourth, the parameter α represents the constant term in the variance equation. To obtain robust inference about the estimated models, we compute the robust standard errors as suggested by Bollerslev and Wooldridge (1992). We estimate ARMA (p,q) – EGARCH (1,1) and *ARMA(p,q) – GARCH91,1)* models using the maximum likelihood estimation technique, assuming normally distributed errors, and the optimal lag lengths are selected using the Schwarz Bayesian Criterion (Schwartz 1978).[2]

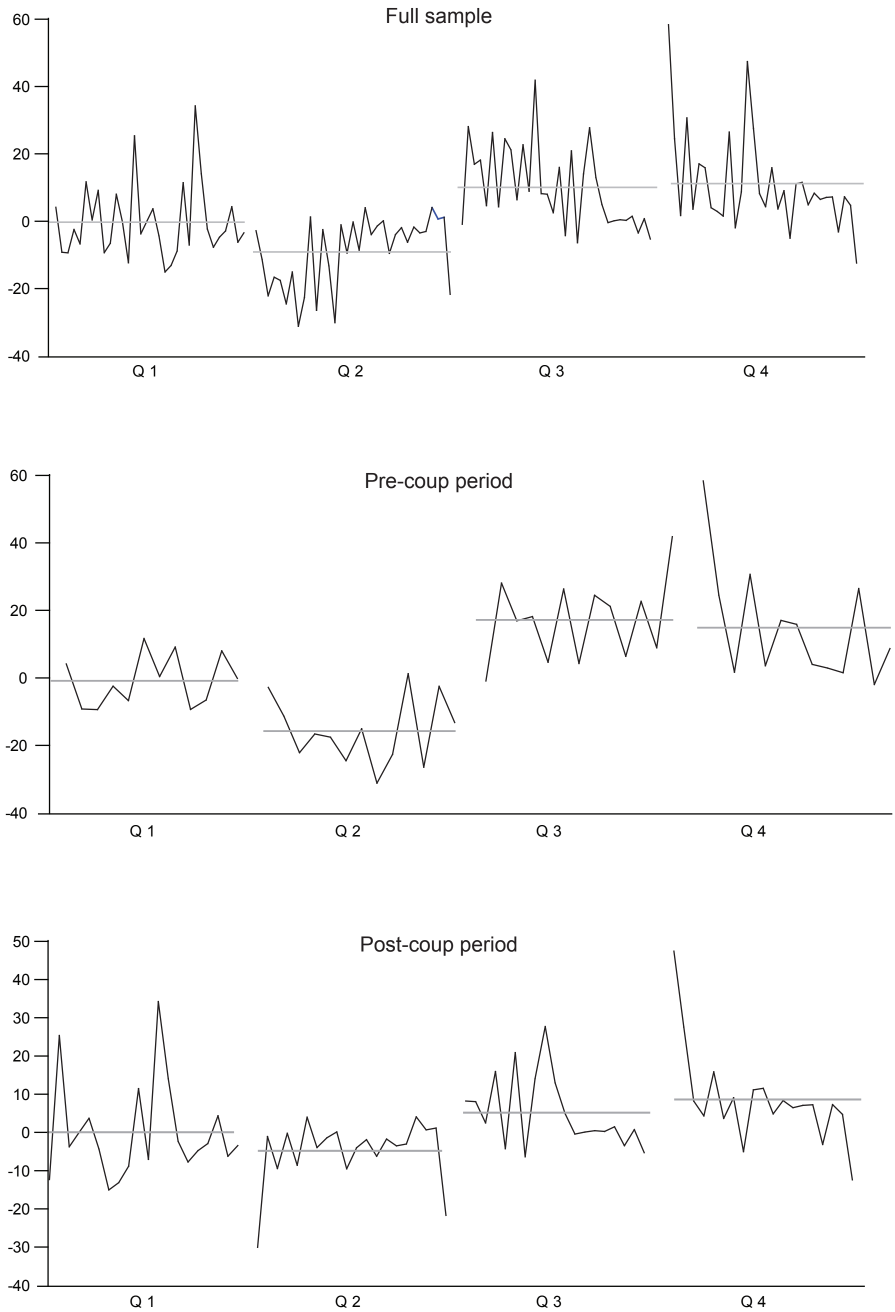
Empirical results

Description of data and basic statistics

We use quarterly data on Fiji's foreign reserves for the period Q1 1974 to Q2 2006. The data were obtained from the RBF's *Quarterly Reviews*. The growth rate in foreign reserves is plotted and shows considerable volatility (Figure 1). We also plot the growth rate in foreign reserves for the pre-coup, coup and full sample periods based on the four quarters (Figure 2). For the full sample period, the mean rate of growth (shown by the horizontal line) is positive for quarters three and four, about zero for quarter one and negative for quarter two. For the pre-coup period, quarters three and four show positive growth rates, while quarters one and two have negative rates of growth. In the coup period, quarters three and four have positive growth rates, quarter one has a zero growth rate, while quarter two has negative growth. In sum, across the three sample periods, quarters three and four show positive growth rates. This is because of increased tourism activities as well as the inflow of sugar receipts at this time. The first-quarter growth rate oscillates around zero, while the second-quarter growth rate is negative. A significant draining of foreign reserve funds marks these two quarters. Notice, however, that the mean negative growth rate is lower in the coup period than in the pre-coup period. This indicates a decline in activities relating to withdrawal of foreign reserves in the coup period.

We present descriptive statistics of the growth rate of foreign reserves for the three sample periods (Table 1). To test for normality, we use tests of skewness and kurtosis, and the Jarque-Bera (JB) test of whether a series is normally distributed. For all three sample periods, the skewness is positive (has a right tail). These tests generally imply that the foreign reserves series is non-normal—hence giving further credence to our use of GARCH/EGARCH models.

Figure 2 **Growth rates by season**



Source: Authors' calculations

Judging by the calculated coefficients of variation, volatility seems to be highest in the coup period. To test for conditional heteroskedasticity, we use the Ljung-Box (LB) statistic of squared residuals (McLeod and Li 1983). For the pre-coup and coup periods, we find evidence of ARCH effects as revealed by the autocorrelations of the squared residuals. For the pre-coup period, the first-order autocorrelation is 0.163 while the tenth-order autocorrelation is –0.131; the autocorrelations oscillate between positive and negative values. The Q-statistic ranges from 1.3 to 13.6 and has a probability value of less than 0.1. For the coup period, there is evidence of significant autocorrelation for up to six lags. The autocorrelations range between –0.013 and –0.167; their probability value is less than 0.1. This confirms the presence of conditional heteroskedasticity.

Unit root test

In this section, we investigate whether the growth rate of Fiji's foreign reserves is stationary. We use a battery of univariate unit root tests—namely, the augmented ADF (Dickey and Fuller 1979, 1981) test, the Philips and Perron (1988) test, the ADF generalised least squares test of Elliot, Rothenberg and Stock (1996) and the KPSS test (Kwiatkoeski, Phillips, Schmidt and Shin 1992). The first three tests examine the null of non-stationarity against mean and trend stationarity, while the KPSS test examines the null hypothesis of stationarity against the alternative of mean and trend non-stationarity (Table 2). We find robust evidence in favour of stationarity of the growth rate of Fiji's foreign reserves.

GARCH results

The results of the GARCH (1,1) model are for three samples: the full sample period, the pre-coup sample period and the coup sample period (Table 3). Beginning with the results from the full sample period, we notice that news about the previous period's volatility is statistically significant and negative, implying that news about the previous period's volatility reduces the volatility of Fiji's foreign reserves.

The shock persistence term is also found to be statistically significant and the coefficient is very close to 1, implying that shocks to volatility have permanent effects on foreign reserves.

Table 1 **Summary statistics**

	Full sample period	Pre-coup period	Coup period
Mean	2.8525	3.0486	2.1408
Median	0.7569	3.2603	0.1922
Maximum	58.3636	41.8311	47.4131
Minimum	–31.1976	–31.1976	–30.0818
Standard deviation	14.520	16.6874	11.8051
Skewness	0.7215	0.0406	0.9319
Kurtosis	4.6937	2.4852	5.7080
Jarque-Bera	26.6128	0.5432	35.1241
p-value	0.0000	0.7621	0.0000
Coefficient of variation	5.0894	5.4738	5.5143

Source: Authors' calculations

Table 2 **Unit root tests**

Panel A: Full sample period	No trend (NT)	Trend (T)	1% CV (NT)	1% CV (T)
ADF	–4.8047	–4.9475	–3.4833	–4.0331
ADF-GLS	–3.7749	–4.2596	–2.5836	–3.5500
PP	–11.1749	–11.4105	–3.4830	–4.0313
KPSS	0.2931	0.0900	0.7390	0.2160
Panel B: Pre-coup period	No trend (NT)	Trend (T)	1% CV (NT)	1% CV (T)
ADF	–5.2674	–5.0142	–3.5847	–4.1756
ADF-GLS	–4.8620	–5.2423	–2.6174	–3.7700
PP	–10.5026	–11.5531	–3.5682	–4.1525
KPSS	0.4351	0.3548	0.7390	0.2160
Panel C: Coup period	No trend (NT)	Trend (T)	1% CV (NT)	1% CV (T)
ADF	–7.9165	–8.4942	–3.5166	–4.0800
ADF-GLS	–3.2080	–3.5710	–2.5949	–3.6636
PP	–6.9668	–7.2926	–3.5167	–4.0800
KPSS	0.3255	0.0928	0.7390	0.2160

Notes: For the ADF and ADF-GLS tests, a maximum of eight lags was specified and the optimal lag length was obtained by using the Akaike Information Criterion. For the PP and the KPSS tests, we used the Bartlett Kernel estimator and selected the bandwidth using the Newey-West procedure.
Source: Authors' calculations

Table 3 **Results based on the GARCH (1, 1) model**

	Full sample		Pre-coup		Post-coup	
	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
δ_1	0.0797	0.6208	0.0021	0.9984	–0.1564	0.6746
δ_2	–0.2232[a]	0.0546	–0.5063	0.4323	–0.3307[a]	0.0512
δ_3	0.1346	0.3528	0.0515	0.9554	–0.3829[b]	0.0247
δ_4	0.6255[c]	0.0000	0.4051	0.5112	–0.1065	0.5283
ϑ_1	–0.1067	0.5383	–0.0712	0.9556	0.2545	0.4742
ϑ_2	0.1594	0.1656	0.2140	0.7637	0.3071[b]	0.0256
ϑ_3	–0.2847	0.0379	–0.5376	0.3626	0.6681[c]	0.0000
ϑ_4	–0.4254[c]	0.0006	–0.3419	0.7496	0.4792[a]	0.0507
C	10.3766	0.1571	155.2841	0.4619	3.1743	0.3427
α_1	–0.1126[c]	0.0024	–0.1689[a]	0.0574	0.0463	0.4916
α_2	0.9545[c]	0.0000	0.5309	0.5088	0.8854[c]	0.0000
COUP	62.4287[c]	0.0050	-	-	-	-
SUGAR	–15.0793[c]	0.0001	-	-	-	-
TOURISM	18.1936	0.1237	-	-	-	-

- zero
Notes: The deltas and upsilons are the ARMA coefficients; c is the constant term in the variance equation and alphas are the ARCH and GARCH terms, respectively.
Source: Authors' calculations

An interesting finding comes to light when we consider the pre-coup and coup periods. In the pre-coup period, news about volatility from the previous period is only weakly significant (at the 10 per cent level), while the impact of shocks on the volatility of Fiji's foreign reserves is insignificant, implying that shocks are not important in the pre-coup period. In the coup period, shocks have a permanent and persistent impact on the volatility of foreign reserves. The relative importance of shocks in the two periods is not surprising. The pre-coup period was relatively calm, with few economic disturbances. The coup period has been marked by several coups and internal and external shocks, such as the expiration of land leases, the turbulent performance of the tourism industry due to coups and the East Asian financial crisis.

Finally, in estimating the results from the full model, we examined the impact of coups, tourism and the expiration of sugarcane land leases on the volatility of Fiji's foreign reserves. The coup dummy variable takes a value of 1 in the years of coups and zero otherwise; the tourism dummy variable takes a value of 1 in quarters one and four of the year—since these quarters are boom periods for tourism—and zero for the other quarters; and the sugar dummy variable takes a value of 1 in the years after 1996, since land leases began expiring in 1997, and a value of zero for the period before 1997.

The results reveal that while coups and tourism have increased the volatility of Fiji's foreign reserves, only the impact of coups is statistically significant (at the 1 per cent level). Coups have dealt significant blows to Fiji's economy. They have in the main led to capital outflow, which has had a direct impact on Fiji's foreign reserves. The expiration of sugarcane land leases has had a negative impact on the volatility of foreign reserves. Expiration of leases reduced volatility mainly because the expiry of leases was well known in advance; once expiration began, it was gradual. It therefore did not create instability through the fall in sugar exports. To some extent, the fall in sugar exports was compensated for by the rise in tourism exports.

EGARCH results

The results from the EGARCH model are also reported (Table 4). We begin with the full sample period model. All parameters are statistically significant at the 1 per cent level in the mean equation, suggesting evidence for ARCH/GARCH effects. More importantly, we find evidence for the asymmetric volatility of Fiji's foreign reserves. The coefficient on γ suggests that positive shocks lead to higher increases in the volatility of foreign reserves than do negative shocks. We also model the impact of coups in Fiji through use of a dummy variable. By using this dummy variable, we are able to obtain a component of the shock term that is defined broadly by the GARCH/EGARCH models. We find that coups have led to an increase in the volatility of Fiji's foreign reserves.

Next, we compare evidence of the volatility of Fiji's foreign reserves in the pre-coup (1974–86) and the coup (1987–2006) periods. We notice several interesting features. First, most of the parameters of the mean equation are statistically significant at conventional levels. Second, in both periods there is statistically strong evidence that foreign reserves volatility is asymmetric. In the pre-coup period, the sign on γ is negative, implying that negative shocks increase volatility more than positive shocks, while in the coup period the coefficient is positive, suggesting that positive shocks increase the volatility of foreign reserves more than negative shocks.

Third, we find that volatility persistence is higher in the coup period. In the coup period, the coefficient on the volatility

Table 4 **Results based on the EGARCH (1, 1) model**

	Full sample period		Pre-coup period		Coup period	
	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
δ_1	–0.0816	0.3959	–0.8564[c]	0.0000	–0.4420	0.1966
δ_2	–0.1416	0.1292	–0.4339[b]	0.0258	–0.5725[c]	0.0040
δ_3	–0.0824	0.3607	–0.2619[b]	0.0121	–0.6396[c]	0.0046
δ_4	0.7735[c]	0.0000	0.2614[b]	0.0308	0.0576	0.8357
ϑ_1	0.1156	0.2548	0.8889[c]	0.0000	0.5808[a]	0.0944
ϑ_2	0.3207[b]	0.0025	0.1054	0.4072	0.7332[c]	0.0001
ϑ_3	0.0745	0.4840	–0.4388[c]	0.0000	0.6642[c]	0.0012
ϑ_4	–0.6541[c]	0.0000	–0.6502[c]	0.0000	0.1791	0.4300
ω	4.8237[c]	0.0000	4.6265[c]	0.0004	7.3657[c]	0.0000
α	–1.0986[c]	0.0000	–0.7462[b]	0.0466	–0.9442[b]	0.0361
γ	0.2000[b]	0.0458	–0.6805[b]	0.0199	1.0178[c]	0.0001
β	0.0837	0.5233	0.1630	0.5268	–0.6288[c]	0.0000
Coup	1.1615[c]	0.0004	-	-	-	-
Sugar	–1.1330[c]	0.0000	-	-	-	-
Tourism	0.5045[a]	0.0547	-	-	-	-

- zero
Notes: The deltas and upsilons are the ARMA coefficients; omega is the conditional variance coefficient; alpha and beta are the ARCH and GARCH terms, respectively; and gamma is the coefficient on symmetry.
Source: Authors' calculations

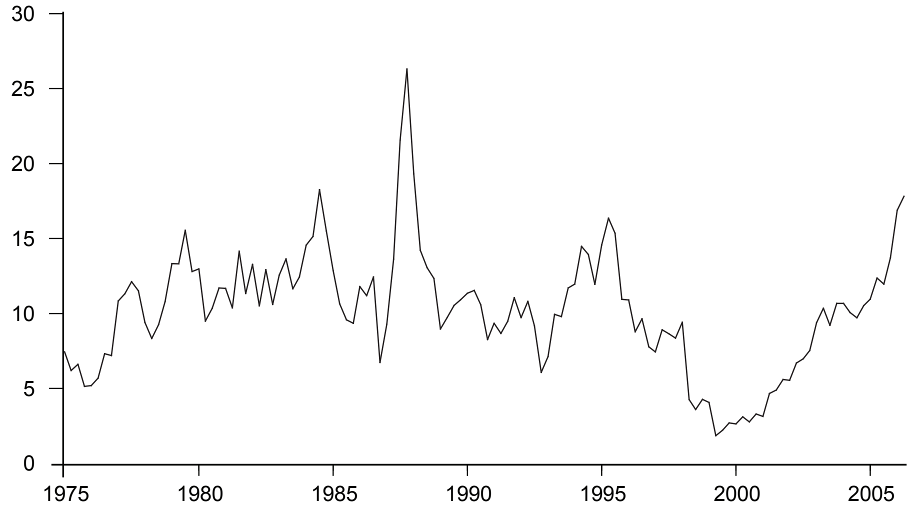
persistence parameter is negative, suggesting that volatility has cyclical behaviour. We captured this behaviour and plotted the conditional standard deviation of Fiji's foreign reserves (Figures 3–5). The cyclical pattern of the conditional deviation is more apparent for the coup sample period.

Shock persistence can be explained by the fact that there were several coups during the 1987–2006 period, creating an environment of political and economic uncertainty. Coups dampened investor confidence, attracted trade bans, reduced visitor arrivals and led to capital outflows (Narayan 2004b; Prasad and Narayan 2005; Chand and Levantis 2000; Gounder 2001, 2002). It is clear that this period of poor investment and economic growth performance was one of the most turbulent for Fiji. As a result, Fiji's foreign reserves were negatively impacted, generating greater volatility of reserves.

Troubled by coups and their repercussions on international trade and Fiji's macroeconomic performance, the Fijian authorities devalued the dollar in 1987 by 33 per cent and in 1998 by 20 per cent. The objective was to increase Fiji's export competitiveness and boost the country's ailing foreign reserves position. The devaluations, however, fostered further insecurity, accentuated capital flight and discouraged private investment. They also promoted speculation of further devaluations.

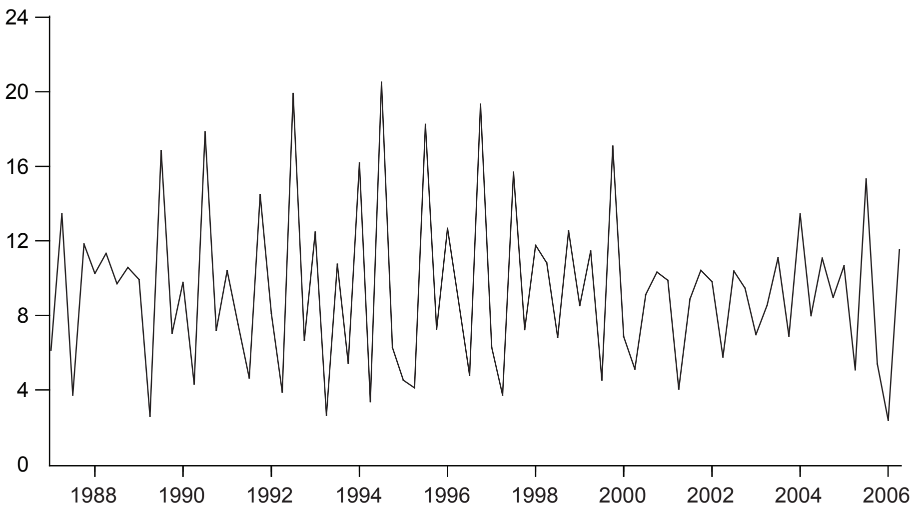
Devaluations, however, made holidaying in Fiji cheaper than previously and the tourism industry helped Fiji rebuild its foreign reserves position. Fiji's travel and tourism industry earns about US$400 mil-

Figure 3 **Conditional standard deviation of foreign reserves, full sample period (1975–2006)**



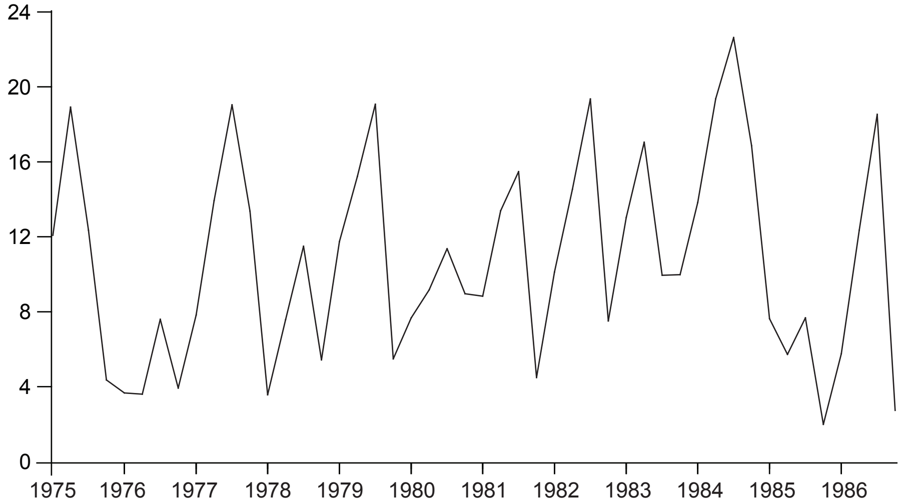
Source: Authors' calculations

Figure 4 **Conditional standard deviation of foreign reserves, coup period (1987–2006)**



Source: Authors' calculations

Figure 5 **Conditional standard deviation of foreign reserves, pre-coup period (1975–86)**



Source: Authors' calculations

lion in foreign exchange annually. Tourism alone, however, cannot rescue the economy since it accounts for about only 15 per cent of GDP. Unfortunately, Fiji's other major export sectors—namely, garments and sugar—have not been performing well in the past decade. This exerted pressure on Fiji's foreign reserves, which declined to less than three months' cover for imports in July 2006. The low and declining foreign reserves started a fresh round of speculation about devaluation. In an attempt to avert fears of devaluation and stem capital outflows, Fiji issued a bond in the international market in the amount of US$150 million to rebuild reserves.

In sum, it is clear that fluctuations in the activities directly relevant to Fiji's foreign reserves position during the coup period (1987–2006) have been relatively high. It is not surprising therefore that the conditional standard deviation of Fiji's foreign reserves in the coup period is also high (Figures 3–5).

Diagnostic tests

In this section, we evaluate whether the estimated GARCH and EGARCH models are well behaved. We begin with a test for ARCH effects in the standardised residuals, using the Lagrange multiplier (LM) test. If the variance equation is specified correctly, there should be no ARCH effect left in the standardised residuals. For the EGARCH model, we find that we are unable to reject the null hypothesis of no ARCH effect in the standardised residuals. For the full sample period, the test statistic is 15.98; for the pre-coup period, the test statistic is 12.86; and for the coup period, the test statistic is 10.28. The associated probability values are all greater than 0.1, implying that the null hypothesis of no ARCH effects cannot be rejected. For the GARCH model, we reach the same conclusion (full results are available from the authors on request).

Apart from the ARCH test, we plot the quantile-quantile (Q-Q) plots of the standardised residuals against a normal quantile to check each of the three sample periods for the EGARCH model (Figures 6a–c). An advantage of the Q-Q plots is that if there are deviations from a normal quantile, one can figure out whether the deviation is caused by negative or positive shocks. If the residuals are distributed normally, the points in the Q-Q plots should lie along a straight line. The Q-Q plot for the full sample is mainly along the straight line, suggesting a normal distribution. There is some indication that large positive shocks lead to departure from normality. For the pre-coup period, while the Q-Q plot suggests normality, there is some evidence that large negative shocks drive the departure from normality. In the pre-coup period, there were global oil price shocks (rises in prices), which could be considered as a negative shock to Fiji's foreign reserves and were likely to have generated a rise in volatility.

For the coup period, some departures from normality can be attributed to large positive shocks, which change foreign reserves and bring about a change in their volatility. This is not a surprising outcome given the magnitude of events that have had a direct impact on Fiji's foreign reserves. The results from the GARCH model are similar and are not reported here, to conserve space, but are available from the authors on request.

We undertake two additional tests for the diagnostic analysis—namely, the Nyblom (1989) test and the sign bias test proposed by Engle and Ng (1993). We begin with the parameter stability test proposed by Nyblom (1989), which was modified by Lee and Hansen (1992) and Hansen (1994). The statistic is an approximate LM test of the null hypothesis that the parameters are constant (stable) against the alternative that the parameters follow a martingale process (see Hansen 1994 for an overview of this test). The results of tests on parameter stabil-

Figure 6a **QQ plot: full sample period**

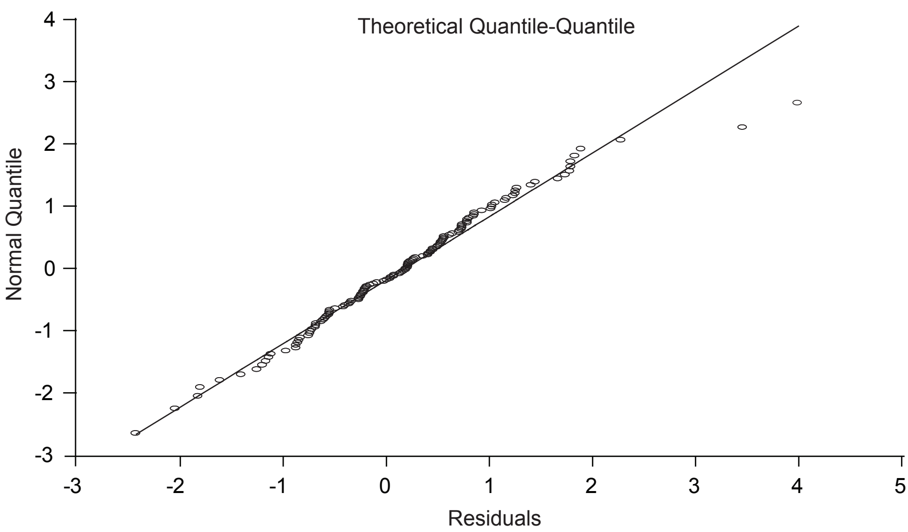


Figure 6b **QQ plot: pre-coup period**

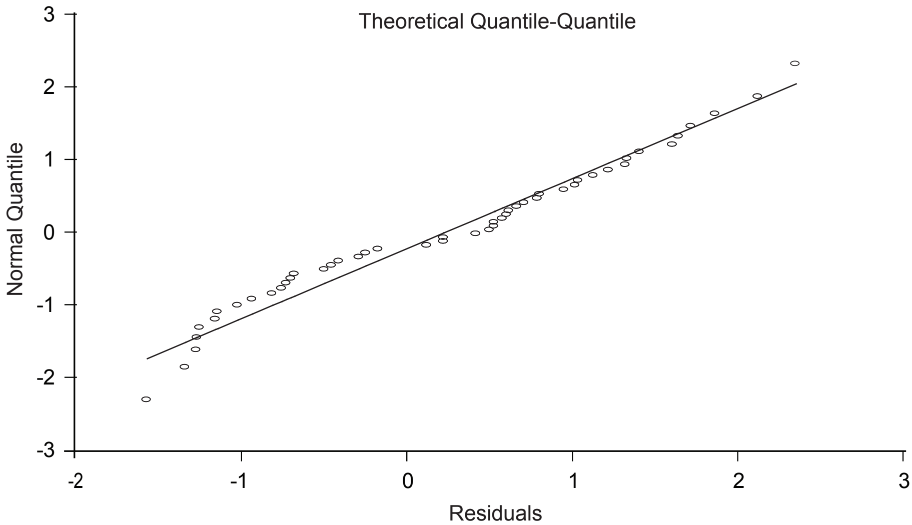
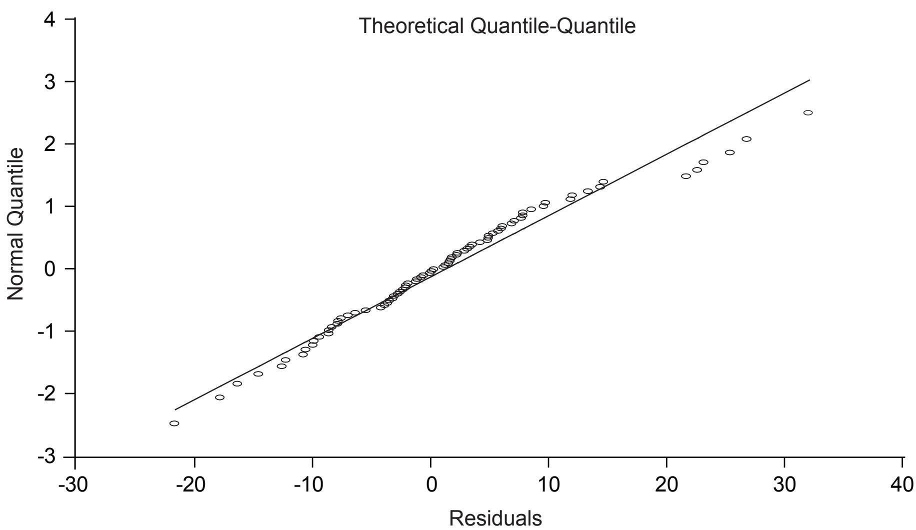


Figure 6c **QQ plot: coup period**



Source: Authors' calculations

ity for the GARCH (Table 5) and EGARCH (Table 6) model results are reported. The test results generally support the null hypothesis that the parameters are stable. In each of the models, only two cases of unstable parameters are found. It follows that the two models perform fairly equally.

Finally, we examine whether volatility is symmetrical using the LM test proposed by Engle and Ng (1993). Essentially, this test regresses a dummy for positive and negative sign biases on the squared residuals and the results are calculated for the GARCH (Table 7) and EGARCH (Table 8) models. For the GARCH model, none of the four tests rejects the null hypothesis. We can therefore conclude that there is no asymmetry in the second moments and positive and negative shocks have the same effect. This means that the size of the shock is irrelevant. On the other hand, for the EGARCH model, the negative sign bias test is significant, implying that there is asymmetry in the second moments and positive and negative shocks have different effects.

Conclusion

The coups in 1987 sparked a period of political and economic uncertainty for Fiji. Fiji's economy was unable to recover and, with another coup in 2000, political and economic uncertainty gained momentum, leading to a further coup in 2006. Fiji's foreign reserves weakened due to poor export performance and growing import demand, to the extent that the reserves position declined sharply to an all-time low of the equivalent of 2.6 months of imports in July 2006. This sparked speculations of devaluation.

In this analysis, we have modelled Fiji's foreign reserves using the GARCH/EGARCH models. More specifically, we address two issues: 1) whether foreign reserve volatility is asymmetric; and 2) whether foreign reserve volatility is persistent. We examined these issues for three sample periods—namely, the full sample period (1974–2006), the pre-coup sample period (1974–86) and the coup sample period (1987–2006). The results

Table 5 **Nyblom test for parameter stability (GARCH model)**

Parameters	Test statistics
Cst (M)	0.0272
AR(1)	0.0305
AR(2)	0.0112
AR(3)	0.0306
AR(4)	0.0107
MA(1)	0.0195
MA(2)	0.0289
MA(3)	0.0178
MA(4)	0.0295
Cst (V)	0.4350
Coup (V)	0.6522[b]
Sugar (V)	0.6380[b]
Tourism (V)	0.3676
ARCH (Alpha 1)	0.1760
GARCH (Beta 1)	0.4467

Notes: The asymptotic 5 per cent and 1 per cent critical values are 0.47 and 0.75, respectively.
Source: Authors' calculations

Table 6 **Nyblom test for parameter stability (EGARCH model)**

Parameters	Test statistics
Cst (M)	0.0162
AR(1)	0.0116
AR(2)	0.0062
AR(3)	0.0133
AR(4)	0.0122
MA(1)	0.0853
MA(2)	0.0516
MA(3)	0.0597
MA(4)	0.1393
Cst (V)	0.1277
Coup (V)	0.0081
Sugar (V)	0.0126
Tourism (V)	0.8289[c]
ARCH (Alpha 1)	0.0520
GARCH (Beta 1)	0.1274
EGARCH (Theta 1)	0.5049[b]
EGARCH (Theta 2)	0.0521

Notes: The asymptotic 5 per cent and 1 per cent critical values are 0.47 and 0.75, respectively.
Source: Authors' calculations

Table 7 **Diagnostic tests based on the news impact curve: GARCH (1, 1) model**

	Test statistic	p-value
Sign bias t-test	0.0329	0.9738
Negative sign bias t-test	0.6590	0.5099
Positive sign bias t-test	0.2724	0.7853
Joint test	0.6070	0.8948

Source: Authors' calculations

Table 8 **Diagnostic tests based on the news impact curve: EGARCH (1, 1) model**

	Test statistic	p-value
Sign bias t-test	0.9684	0.3328
Negative sign bias t-test	1.8385	0.0660
Positive sign bias t-test	1.2683	0.2047
Joint test	6.0380	0.1098

Source: Authors' calculations

suggest that foreign reserve volatility is asymmetric. This means that the impacts of positive and negative shocks on the volatility of foreign reserves are different. We find that while in the pre-coup period negative shocks generated higher volatility in foreign reserves than positive shocks, in the coup period, positive shocks generated a larger increase in foreign reserve volatility than negative shocks. We argued that this behaviour might be due to the greater magnitude of events in the coup period that were directly relevant to Fiji's foreign reserves. Importantly, in the coup period, we find evidence of shock persistence. This means that whatever the shock (negative or positive) is, it has a lasting (long-term) impact on the volatility of foreign reserves. A sustained period of volatility, as a result of a shock, can create macroeconomic instability, particularly if the shock leads to declining foreign reserves. This has been the case in Fiji.

The implications of our findings can be summarised as follows. First, it is clear that in the coup period, marked by political and economic instability, the volatility of Fiji's foreign reserves increased. The higher the volatility, the higher the level of speculation that can be expected, as low foreign reserves foster speculation of devaluations. High volatility of foreign reserves has implications for individual/investor behaviour. If a low foreign reserve position is an indicator of devaluation—which is the case for Fiji given the failure of macroeconomic policies—this can trigger capital flight. Second, higher foreign reserve volatility also fosters uncertainty, which has direct relevance for investor confidence.

Notes

[1] The ARCH effect is related to the presence of heteroskedasticity in the error terms. It arises when the variance of the error term is not equal or when the error terms are large at some points or larger over a range of data than the others (Engle 2001). When error terms are heteroskedastic, it makes the ordinary least squares (OLS) estimator inefficient. The ARCH and GARCH models and their extensions account for this heteroskedasticity in the error term and are able to avoid the deficiencies of the OLS estimator.

[2] While use of the Schwartz (1978) criterion for lag length selection is standard practice, the ability of this procedure has some limitations (see Enders 2004).

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